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BIOMECHANICAL EVALUATION OF GAIT IN THE ELDERLY OF THE GRAND PARENTS CIRCLE "CELIA SÁNCHEZ MANDULEY"

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ABSTRACT

The objective of the research is to evaluate the gait deficiencies of older adults of the grandparents' circle of Villa Clara, Cuba, information was collected for the individualization of the physical activities to which they are subjected. Material and methods, a transversal study was designed in time, in which 8 subjects were intentionally selected. The empirical methods applied were biomechanical analysis and descriptive statistics. Biomechanical methods and descriptive statistics were used to evaluate the gait of the subjects to determine their mean age, as well as the behavior of a group of indicators that allowed characterizing the gait of the adults investigated. The results, descriptive statistics showed that the mean age of the subjects in the sample was 70.5 years. The findings of the biomechanical study showed that the ankle indicators in the different gait positions, the mean data differed from the model, highlighting the pre-swing with a difference of 4.92º and the initial support and final swing with differences of about 3º. This behaves similarly in relation to the knee and trunk. Conclusion, the biomechanical evaluation of the gait allowed us to obtain information for the individualization of the physical activities they receive, which facilitates a better adaptation.

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INTRODUCTION

Aging is an inherent phenomenon in all living beings (Morales, 2019; Herrera, 2015) and occurs throughout the entire life cycle. As people age, changes in their health occur, structures are altered and the functions of cells and tissues in all body systems are reduced. The World Health Organization3 defines aging as a physiological process that begins with conception and causes changes characteristic of the species throughout the life cycle, which cause a limitation to the adaptability of the organism in relation to the environment, whose rhythm occurs in the different organs of the same individual or in different individuals unequally. It has been proven that (Izquierdo, 1998) a person is aging when certain physical characteristics (gray hair, wrinkles, slowness), psychological (lack of motivation for certain activities, decrease in vital energy) and social (isolation, loss of roles or little participation), but it is not only the age indicator that defines it. People age in different ways depending on their individuality and subjectivity, conditioned by biological, psychological, and social factors. An essential feature of aging is the gradual decrease in the possibilities of movement, as well as changes in balance and March. A functional definition of these disorders refers to march that is slow, unstable, or biomechanically compromised, so much to be ineffective for the person to move normally (OMS, 2014). Frequent balance alterations in the elderly population constitute a risk of falls and injuries. Every year 20-30% of the elderly who live independently fall, in 25% of cases a major injury occurs and in 5% a fracture (WHO, (2014). Many older people voluntarily limit their activity due to concerns about their motor skills and fear of falling. March preservation is one of the most important requirements for a satisfactory old age. Studies carried out (Franc, 2018) show a gradual increase in March disturbances, in correspondence with increasing age. In the international order, some studies show the possibilities and applications of biomechanical analysis to health and the correction of defects, among them, one developed in Spain (Amaia, 2014), linked to the application of the three-dimensional biomechanical model to the orthosis and prostheses. Similarly, another of the investigations (González, 2017) intervenes on the biomechanical analysis of March

through an analytical model of inverse dynamics, in patients with altered sagittal balance of the spine, contributed to the history of biomechanical analysis. In Cuba, researchers (Morales, 2019; Dosán & Vit, 2018; Martínez, 2017; Pérez, 2011) of the University of Medical Sciences of Villa Clara, delve into the particularities of aging and the characteristics of the elderly, based on the Masters in "Satisfactory Longevity", and "Primary Health Care", from the angle of falls, their consequences (traumatic injuries) and how to prepare health professionals to attend them from the profiles of Physical Therapy and Rehabilitation. Considering the above, it is assumed as the objective of this research; evaluate the march in the elderly of the Circle of Grandparents "Celia Sánchez Manduley" in Santa Clara, with the purpose of having a reference for the individualization of the physical activity program where they participate.

MATERIAL AND METHODS

The research that was developed is of an applied type, where a cross-sectional study was carried out at a fixed time on the problems of the elderly adult's march. In the work, scientific methods were used, of the theoretical level and of the empirical level: From the theoretical level: analytical-synthetic, inductive- deductive and modeling: From the empirical level: survey: it allowed to know data of interest of the subjects under study from a group of indicators. Documentary analysis: made it possible to contrast the conditions of the subjects under study with the National Survey on Aging of the Population. (National survey on the aging of the population ENEP, 2017) The biomechanical method: it was applied for the evaluation of the march of the sample subjects, for which the "Kinovea" software was used. Statistical-mathematical method: descriptive and inferential statistics were used. The mean, standard deviation, variance, maximum and minimum values, and empirical frequency distribution were calculated for the purpose of describing the spot of the research subjects. The research was carried out at the "Celia Sánchez Manduley" Circle of Grandparents, in Santa Clara, Villa Clara province.

A sample of eight female adults was selected from an intentional sampling that consisted of the systematicity of the elderly to physical activities; that they do not require auxiliary means for walking and that the diseases and disorders they suffered were typical of aging. The eight subjects participating in the research gave their consent to participate in it. Procedures were applied to obtain data, in accordance with the ethical precepts of the research, contained in the Declaration of Helsinki, which was endorsed by the Scientific Council of the Faculty of Physical Culture of the Central University "Marta Abreu" de Las Villas the Biomechanical Method used is based on the following procedure. The analysis on the technical model of the movement of human march. Aspects to consider in the analysis of the technique. Recommendations for effective filming. Use of biomechanical software for movement analysis (in this case the Kinovea. The interpretation of the results The selected model: it is based on four phases and the march cycles and appears below: In the study of march (Martín & Calvo, 1999) four phases, times or moments are distinguished, although these could be subdivided as other authors do. (Figure I). The aspects to take into account to assess march in the elderly are derived from the phases and cycles of march, as described below:

First phase: Also called double impulse rear support. It is characterized by the fact that the rear lower limb leans forward due to a hip extension, the knee flexes while the tibiotarsal joint flexes plantarly.

Second phase: It is the time or moment of the march, called by other authors oscillating period. In it, the foot that in the previous phase only supported with the big toe is lifted off the ground; the knee and hip are flexed.

Third phase: Called double anterior reception support. It is characterized because the oscillating lower limb that in the second phase crossed to the contrary touches the ground through the heel, receiving part of the weight of the body.

Fourth phase: Called unilateral support. During this phase, the supported lower limb supports the entire weight of the body while maintaining balance in the three planes and allowing the body to move forward. Recommendations for effective filming (Guchin et al, 2015) Camera

Bookmarks: Lighting.

Clothing

- The software chosen was "Kinovea" is a video editing program designed to analyze images and study sports videos in order to find faults, improve technique and help training. (Lluch, 2012)
- Interpretation of the results it was made from the results provided by the software, and the comparison between these and the selected model (ankle, knee, and trunk) in each of the sample subjects.

RESULTS

Descriptive statistics made it easier to know that the average age of the subjects in the sample is 70.5 years. The chronic diseases they suffer from are arterial hypertension (HTN), 62.5%; three have diagnosed diabetes mellitus (37.5%); one of them suffers from hypothyroidism (12.5%) and seven (87.5%) have musculoskeletal diseases, characteristics that fully correspond to the results of the latest National Survey on Aging of the Population11. The most widely used drugs are diuretics (Chlorthalidone and Hydrochlorothiazide) and antihypertensive drugs (Enalapril) to control hypertension; Mecformin and Insulin in the case of diabetics and Levothyroxine sodium is administered to the patient with thyroid problems. Reduce skeletal muscle pain with Duralgine, Paracetamol and Methocarbamol. It was also known that the highest percent of the subjects in the sample, due to their professional occupations, spent long working hours in a bipedal position.

DISCUSSION

The normal march cycle has been divided into two phases, the support phase (it constitutes 60% of the cycle) and the swing phase (it constitutes 40% of the cycle). 12 In Table 1, related to the variables corresponding to the ankle indicator of the subjects under study, differences can be seen between the average data of each variable and the march model used12, highlighting the differences in the variables, response to load, which is between 2-7º, pre- balance with 5th and final swing with 3rd. Only the minimum values in initial support and final swing are close to the values of the model. The values of the mean, response to load, pre - balance and final balance are the values that are the furthest from the model, although it is important to note that the pre - balance results present a large dispersion and difference between the minimum and maximum value makes the analysis of the mean in that variable affects the analysis.

As stated in the National Survey on Aging of the Population, the population aged 50 and over has to do with the musculoskeletal system. Hence, despite the positive influence that physical-recreational exercises exert on these adults, they affect them. As stated in the National Survey on Aging of the Population, the population aged 50 and over has to do with the musculoskeletal system. Hence, despite the positive influence exerted on these adults by physical-recreational exercises, musculoskeletal disorders, and the decrease in physical capacities, it causes march errors that will be latent although they may have a slight improvement with physical activity.

Table 1. Statistical results for each indicator of the ankle in the march

Subjects	Minimum	Maximum	Mean	Model	Differencee between mean and model	Standard Deviationn	Variancee
Initial support	1.4	6.4	3 º	0 º	3 º	1.6	2.57
Loadresponsee	1.6	11.2	3 º	5-10º	2-7º	3.3	10.92
Medium msupport	1.1	17.2	3.6 º	5º	1,4 º	5.5	30.33
Final support	2.8	38.5	7.7 º	10 º	2,3 º	12.4	154.53
Pre-swing	2.2	54.3	10º	15 º	5 º	17.8	319.96
Initial swing	1.7	4.3	2,8 º	5 º	2,2 º	.86	.74
Mediumswing	2.3	4.4	2,8 º	0 º	2,8 º	.65	.43
Finalswing	1.6	3.9	3 º	0 º	3 º	.79	.62

Table 2. Statistical results for each knee indicator in the march

Subjects	Minimum	Maximum	Mean	Model	Differencee betweenmean and model	StandardDeviationn	Variancee
Initialsupport	2.1	15.5	8 º	0-5º	3 º	5.75	33.17
Loadresponse	14.6	28.6	21 º	20 º	1 º	5.78	33.45
Medium upport	10.8	19.1	14 º	0-5º	9 º	3.41	11.65
Final support	1.7	23.3	9 º	0-5º	4 º	9.01	81.21
Pre-swing	18.2	43.1	29 º	40º	13 º	8.52	72.70
Initial swing	21.7	53.5	46 º	60-70º	14º-24º	10.29	105.89
Mediumswing	14.2	26.1	18 º	25 º	7 º	3.59	12.94
Final swing	4.9	20.0	11 º	0-5º	6 º	6.44	41.51

Table 3. Statistical results for each trunk indicator during the march

Subjects	Minimum	Maximum	Mean	Model	Differencee betweenmean and model	StandardDeviationn	Variancee
Initialsupport	9.1 º	13.6 º	10º	20 º	10 º	1.45	2.11
Loadresponse	6.8 º	12.9 º	9 º	20 º	11 º	2.33	5.43
Medium support	-1.2º	10.1 º	6 º	0º	6 º	3.64	13.25
Final support	-7.2º	-3.8º	-5º	-20º	-15º	1.03	1.06
Pre-swing	-6.7º	-4.1º	-57º	-10º	-47º	.90	.82
Initial swing	9.8 º	12.9 º	11º	15 º	4 º	.89	.79
Mediumswing	11.1 º	18.1 º	14 º	25 º	11 º	2.46	6.06
Final swing	10.9 º	14.6 º	12 º	20 º	8 º	1.06	1.13

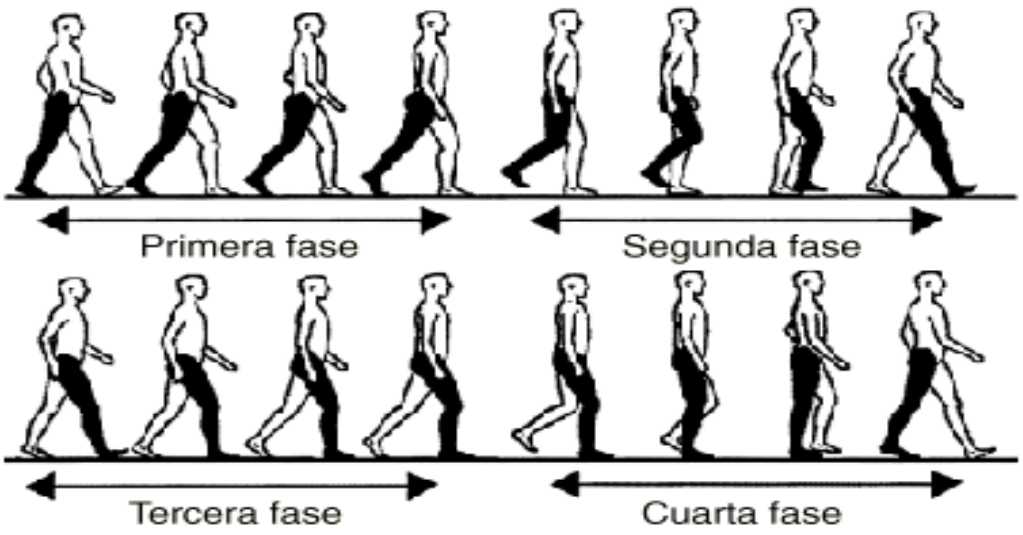

Figure 1. Model of the four phases of the human march (Martín et al., 1999)

The Table 2 shows the statistical results of the knee and the data of the march model. It shows how the mean values are distant from the model with a difference in the mean support of 9º, in the pre-roll of 13º, in the initial roll between 14º-24º and in the average roll with 7º, behaving with a greater dispersion, the variable, initial swing. It is difficult in subjects who have an average age of 70 years of age, who do not have difficulties in walking, motivated by a loss in the levels of reaction force, flexibility, among other limitations, which must be attended through recreational physical activities. Table 3 shows the statistical results of the trunk and the data of the march model. In this table there are many variables with marked differences with the human march model. Among these are the initial support with 10º difference, response to the load with 11º, final support with -15º, medium roll with 11º and the pre-roll with -47º.

The greater or lesser flexion of the trunk is mainly conditioned by the muscles of the back and there is a tendency to walk with errors. As has been seen, we agree that an essential feature of aging is the gradual decrease in the possibilities of movement, as well as changes in balance and march. A functional definition of these disorders refers to the march that is slow, unstable, or biomechanically compromised, so much to be ineffective for the person to move normally, who does not mean that an older adult subjected to a program of physical activity may not improve your locomotion. The results obtained allow an individualization of the physical-recreational activities, which is essential for the adaptation of these subjects to them, hence its practical application, because to the extent that these activities are personalized, the results will be better. In the international order, several works show the possibilities and applications of

biomechanical analysis to health and the correction of defects; however, the studies to which reference has been made do not address the issue of the march of the elderly from a biomechanical perspective. It is considered important to carry out studies with experimental designs in the future to determine causes and effects in the problem studied. The application of the "Kinovea" software in the elderly from the "Celia Sánchez Manduley" Circle of Grandparents of the Julio Antonio Mella Sports Complex in Santa Clara made it possible to detect difficulties in the march of the studied subjects. Highlighting great differences with respect to the human march model. We thank the Circle of Grandparents "Celia Sánchez Manduley" for her collaboration in the study carried out with the grandparents of that institution.

CONCLUSION

The biomechanical evaluation of the gait of the elderly allowed us to obtain information for the individualization of the physical activities they receive, which facilitates a better adaptation to them.

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